

# **Municipal Wireless Broadband: What Have Other U.S. Cities Done?**

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# Why Are We Here? Because Broadband Matters

- **MIT/CMU study of broadband's economic impact**
  - Funded by Department of Commerce and matching funds from industry sponsors of MIT's Communications Futures Program
  - Conducted by William Lehr, Marvin Sirbu, Carlos Osorio and Sharon Gillett
  - National-scale statistical study, comparing 2002 economic indicators by zip code, distinguishing communities by their BB availability in 1999 (as reported by FCC)
- **Data consistent with conclusion that broadband positively affects economic activity**
  - Even after controlling for community-level factors known to influence BB availability and economic outcomes
  - Controls: urban, income, education, growth in previous period
  - Usual academic caveats: data early and limited; potential methodological refinements

Economic Indicator	Results
Employment (Jobs)	BB added about 1% to growth rate 1998-2002
Property Values	Housing rents more than 6% higher in 2000 where BB available by 1999
Number of Firms	BB added nearly 0.5% to growth rate in number of business establishments, 1998-2002
Industry Mix	BB added over 0.5% to share of establishments in IT-intensive sectors, 1998-2002

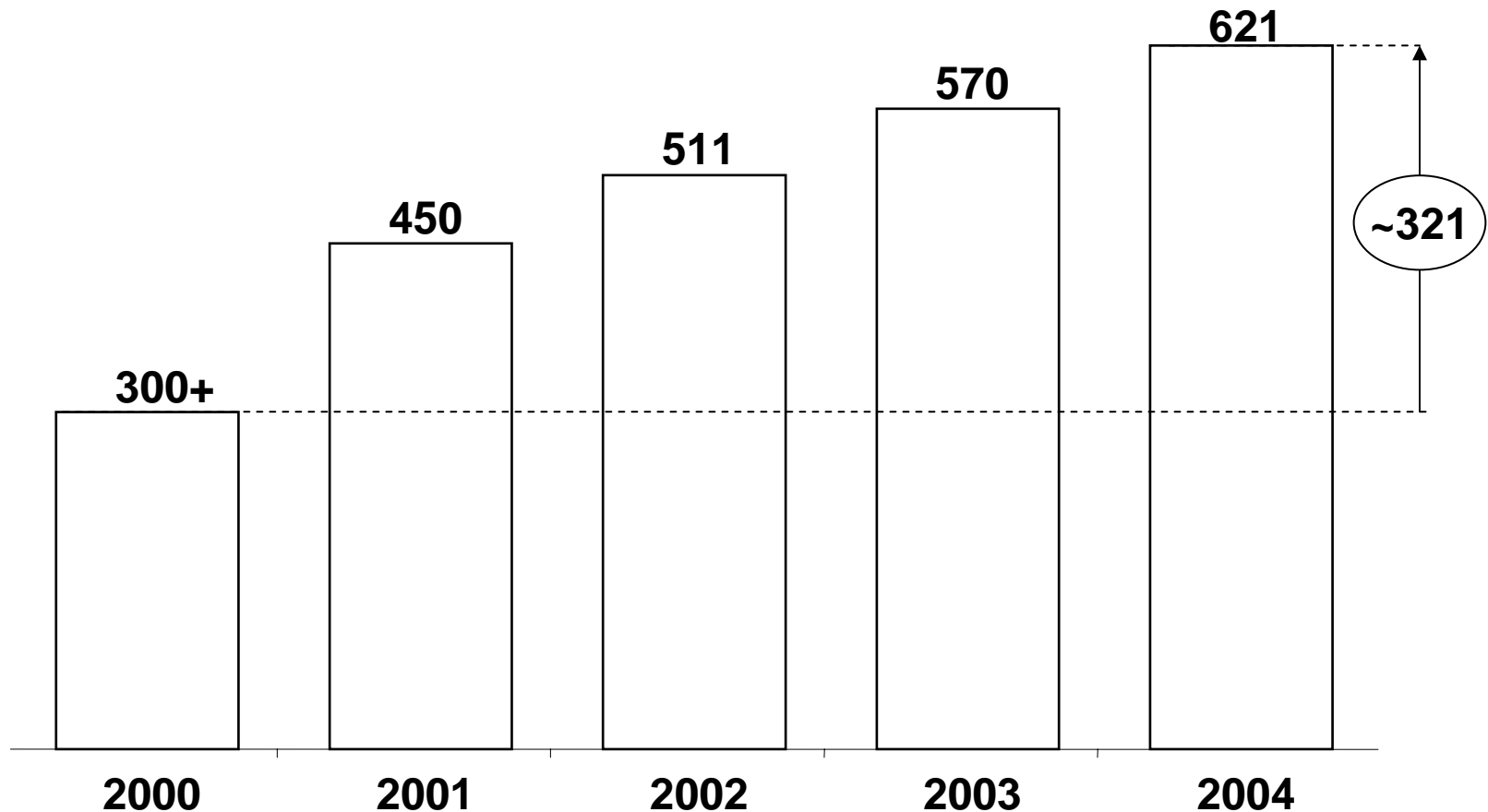
# Key Takeaways

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- **Number of U.S. cities and counties sponsoring wireless / broadband networks is small, but growing rapidly**
- **Cities have adopted three basic models**
  - (1) Self-provision wireless to meet city's own needs
  - (2) Serve the public directly
  - (3) Public-Private Partnerships (hybrid) – typical in major cities
- **Partnerships typically leverage existing city resources**
  - Implies need for *inventory*
  - City resources include city facilities, infrastructure, and buying power (wireless demand)
  - Existing non-profit institutional resources and wireless networks also strong in Boston
- **Best-practice partnerships avoid exclusivity**
  - How to manage multi-party access to city facilities? Treat like rights-of-way?
  - “Open access” (wholesale/retail split) model popular but fuzzy

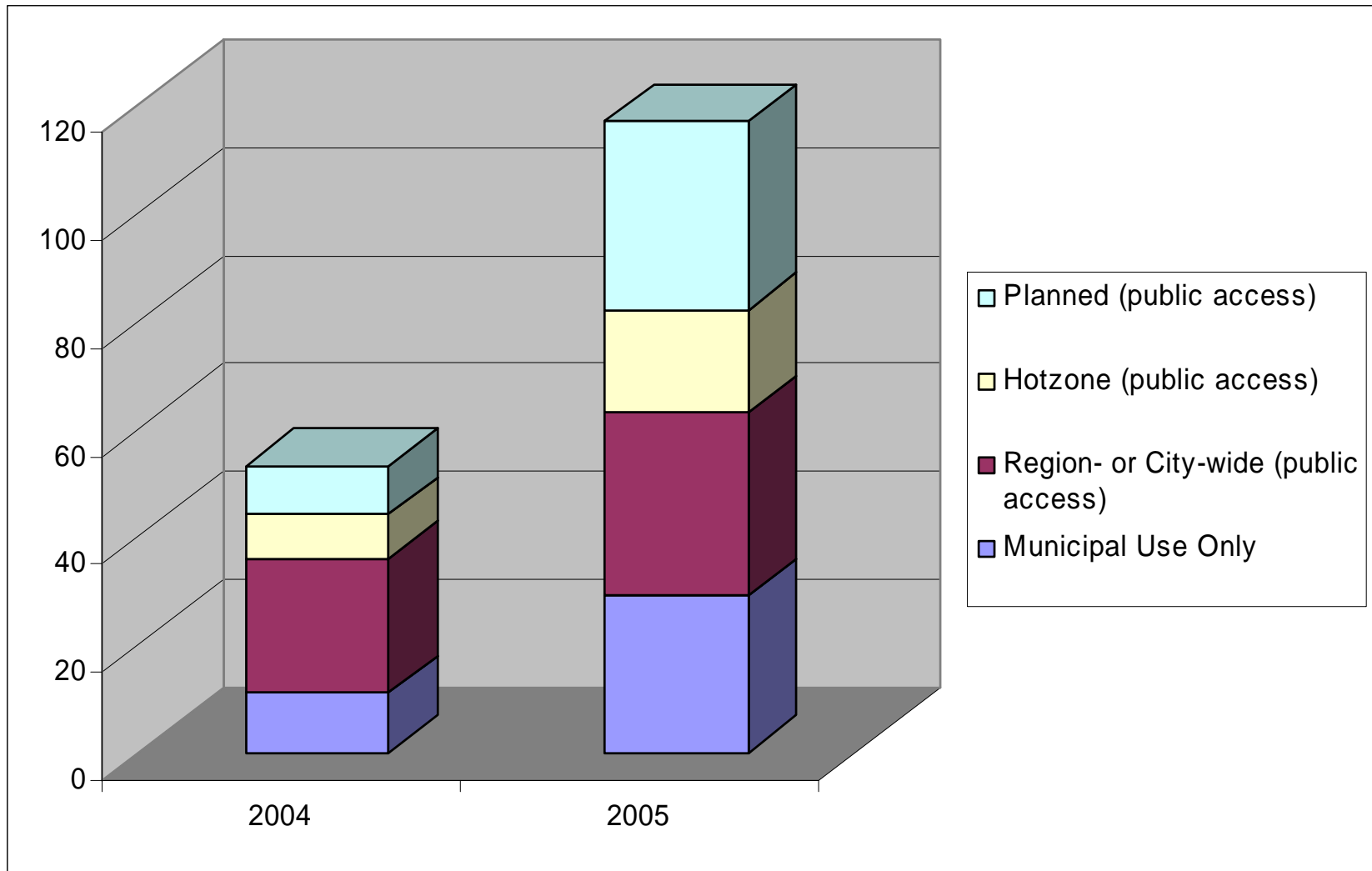
# U.S. Muni Electric Utilities Doing Communications

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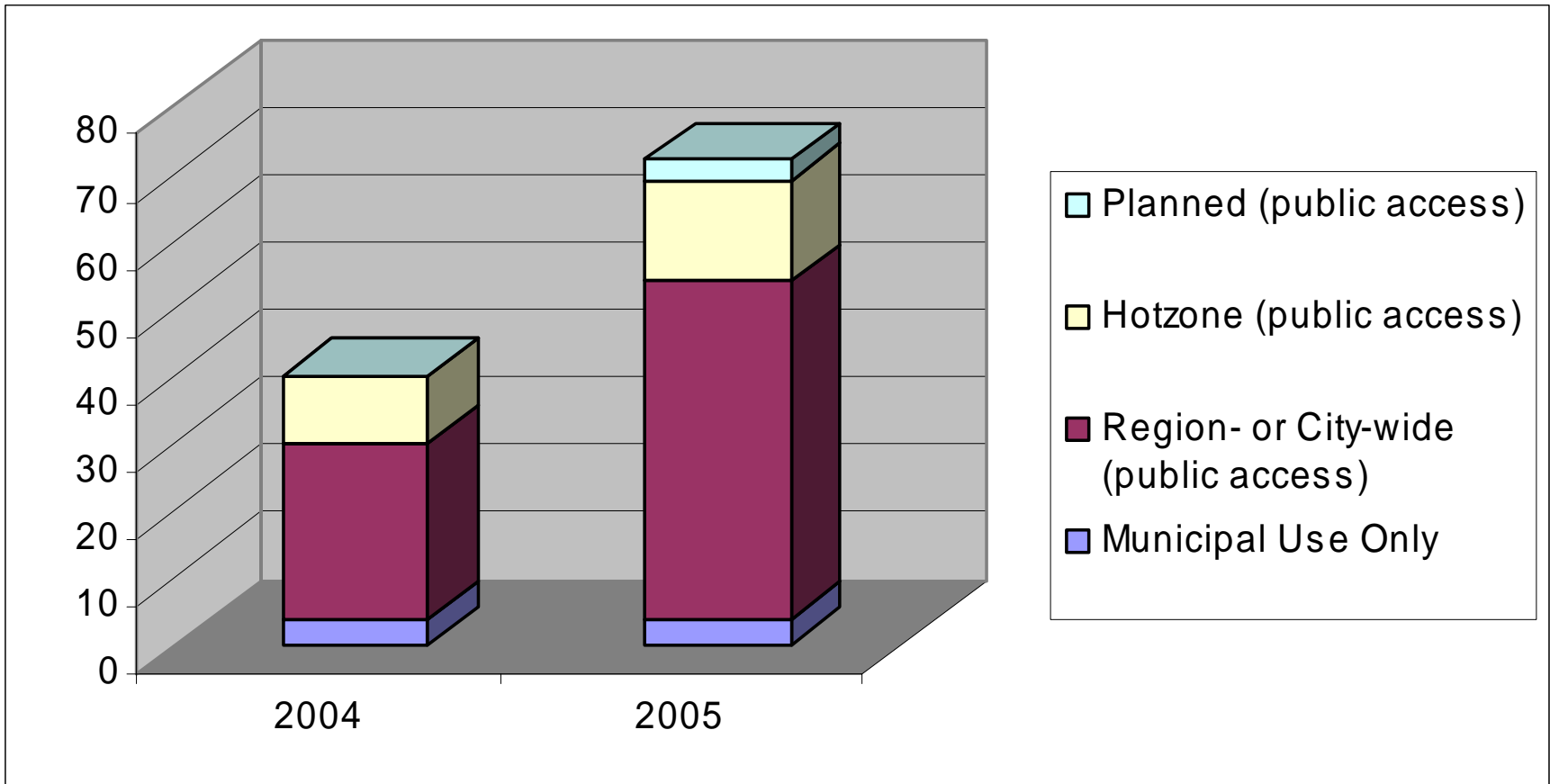
Of about 2,000 MEUs in U.S.  
Source: American Public Power Association

# U.S. Muni Wireless Deployments



Source: MuniWireless.com Anniversary Reports (Esme Vos)

# Non-U.S. Muni Wireless Deployments



Source: MuniWireless.com Anniversary Reports (Esme Vos)

## **Model 1:**

### **Self-provision Wireless to Meet City's Own Needs**

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- **Part of broader “Customer-owned Network” trend (fiber and wireless)**
- **Enabled by unlicensed wireless spectrum**
- **Motivation: More bandwidth and/or more ubiquitous coverage => more efficient city services for less money**
- **Dominated by public safety today, but future possibilities limited only by imagination**
  - Homeland security and emergency preparedness in addition to day-to-day policing
  - Other mobile city workforce (inspectors, meter readers, ...)
  - Sensor (RFID)-based applications (parking meters, traffic lights, rubbish bins...)
  - Urban traffic and parking management (e.g. Denver, CO)
  - Road maintenance (potholes)

# City's Own Use: Customer-Owned Network in San Mateo, CA

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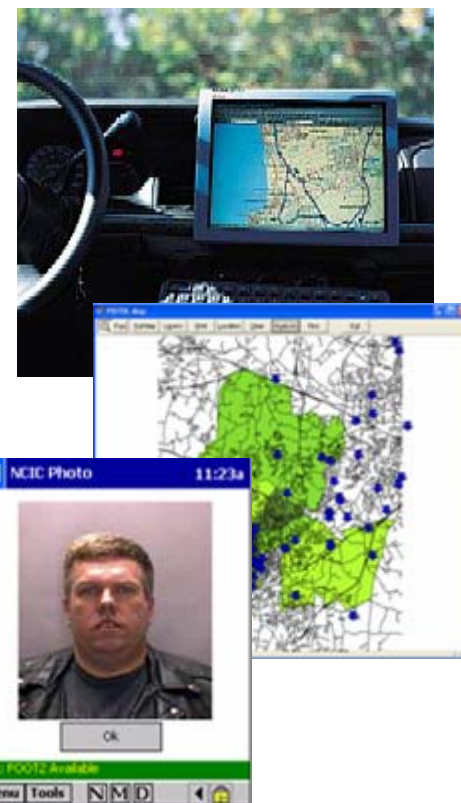
- **Public Safety Network**

- Wi-Fi mesh network, on city-owned light poles
- All HQ broadband applications now mobile
  - Mug shots, fingerprints, Amber alerts, GIS data, HazMat data
- New applications easily enabled
  - Real-time video surveillance, VoIP
  - Mobile, tactical broadband networks

- **Low cost**

- \$50k grant funding
- Lower cost than the 19.2Kbps data radio system it replaced
- “Edge” investments replace recurring costs
- Same user equipment works in car and at HQ

**Significant Productivity and  
Efficiency Improvement**



Sources: Ron Sege, Tropos;  
Muniwireless.com



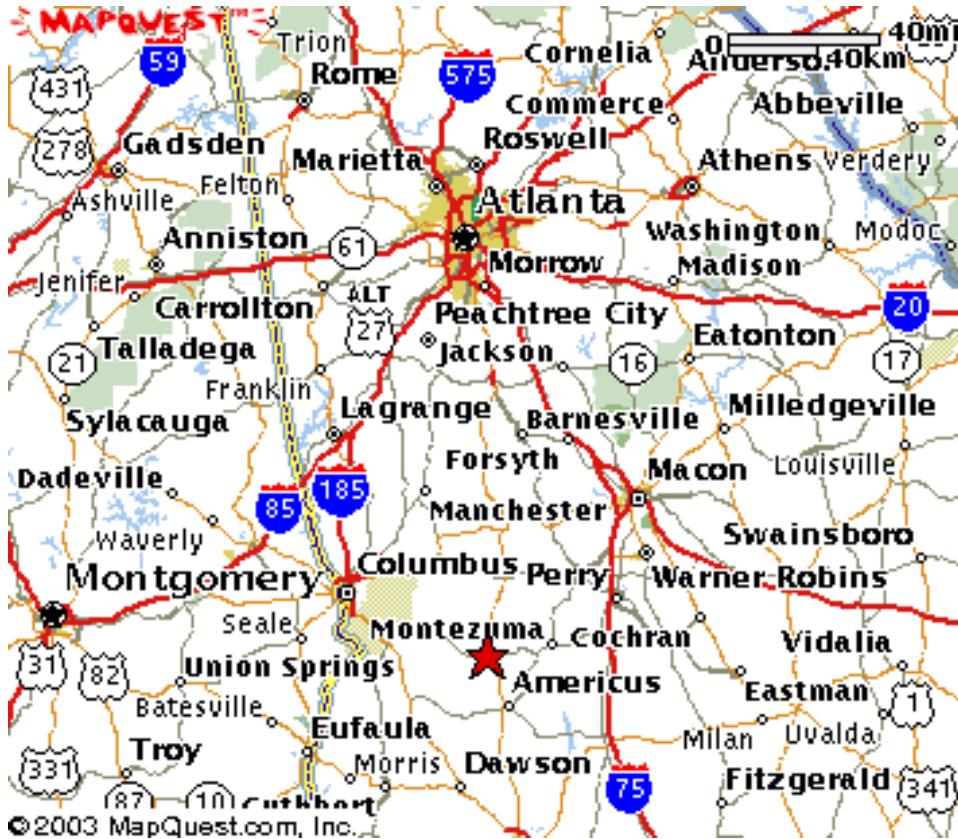
## Model 2: Serve the Public Directly

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- **Hotspots, businesses, or homes**
- **Motivation: digital divide, economic development**
- **Dominated by communities with publicly owned electric utilities**
  - E.g. Chaska, MN and Scottsburg, IN
  - Already have all the customer-service staff and infrastructure in place
  - Can often build on a municipally owned fiber ring already in place
  - These communities are “special” and not particularly good templates for larger, non-MEU communities like Boston

# Serving the Public Directly: Ellaville, Georgia Municipal Electric Utility

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- Population <2,000
- 3 antennas on City's main water tank
  - 2.4 GHz LOS (Alvarion) + 900 MHz N-LOS (WaveRider) – trees!
- \$200,000 upfront cost
- Users pay for service (~1 Mbps @ \$30-45/mo), modem (\$200) + antenna (\$100-150)
- 1.5 Mbps backhaul (ouch)

## Small Cities Serve Their Own

[http://www.isp-planet.com/fixed\\_wireless/business/2002/municipal.html](http://www.isp-planet.com/fixed_wireless/business/2002/municipal.html)

June 25, 2002

[www.epride.net](http://www.epride.net)

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## Model 3: Public Private Partnerships (PPP)

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- **Hybrid approaches typically addressing needs of both city and community**
- **Motivation: “Economies of scope”**
  - Leverage city resources to reduce cost, improve quality of city services *and* facilitate entry by non-muni actors (private sector and non-profits)
- **Dominant model among planned initiatives in major cities**

# Public-Private Partnership: Cerritos, CA Dual-Use WiFi Mesh Network

- **Fast and simple**
  - Commodity 802.11b clients
  - Less than 1 month to install
- **True metro-scale**
  - 9 sq. miles
  - 17,000 homes passed
  - 50,000 residents
- **Low cost to own and to operate:**
  - <\$600k *total* CAPEX
  - One wired backhaul link for the network
    - POP to Internet
  - No special CPE; no truck rolls
  - \$15 opex/sub @15% penetration
- **Bands used: 2.4 GHz**



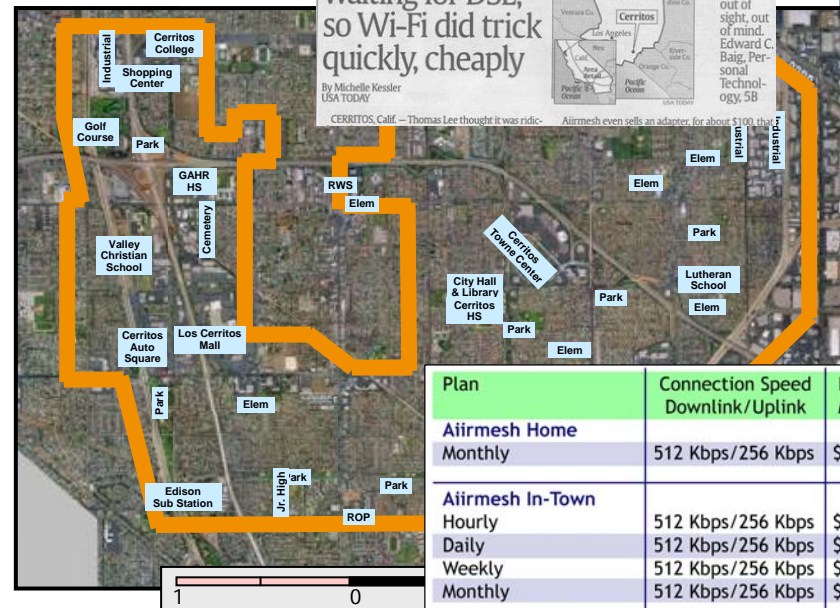
## City takes fast track to high-speed access

Town got tired of waiting for DSL, so Wi-Fi did trick quickly, cheaply

By Michelle Kessler  
USA TODAY



► New TV ensures cords are out of sight, out of mind. Edward C. Baig, Personal Technology, 58



Plan	Connection Speed Downlink/Uplink	Price/ Month
<b>Aiirmesh Home</b>		
Monthly	512 Kbps/256 Kbps	\$29.99*
<b>Aiirmesh In-Town</b>		
Hourly	512 Kbps/256 Kbps	\$4.99
Daily	512 Kbps/256 Kbps	\$8.99
Weekly	512 Kbps/256 Kbps	\$17.99
Monthly	512 Kbps/256 Kbps	\$29.99*
<b>Aiirmesh BusinessPro</b>		
Monthly	1 Mbps/1 Mbps	\$249.99*

\*Annual contract agreement required.

Source: Ron Sege, Tropos

# Diverse PPP approaches

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- **Philadelphia, PA**

- City leases to Earthlink access to city fixtures for wireless antenna placement
- City requires “open access” i.e. wholesale access for other ISPs on resulting Earthlink network
- Earthlink agrees to invest \$10-15m and charge “low” wholesale rates
- Wholesale profits feed into digital divide funds (taxation by another name)
- Analogous to cable franchise, but many details still not clear / public

- **Anaheim, CA**

- Exclusive deal with Earthlink, but “open access”

- **Tempe and Chandler, AZ**

- Non-exclusive deal with NeoReach

- **San Francisco, CA**

- Six proposals
- Google and SF Metro Connect both proposing free-to-end-user access + advertising support + options for paid service tiers

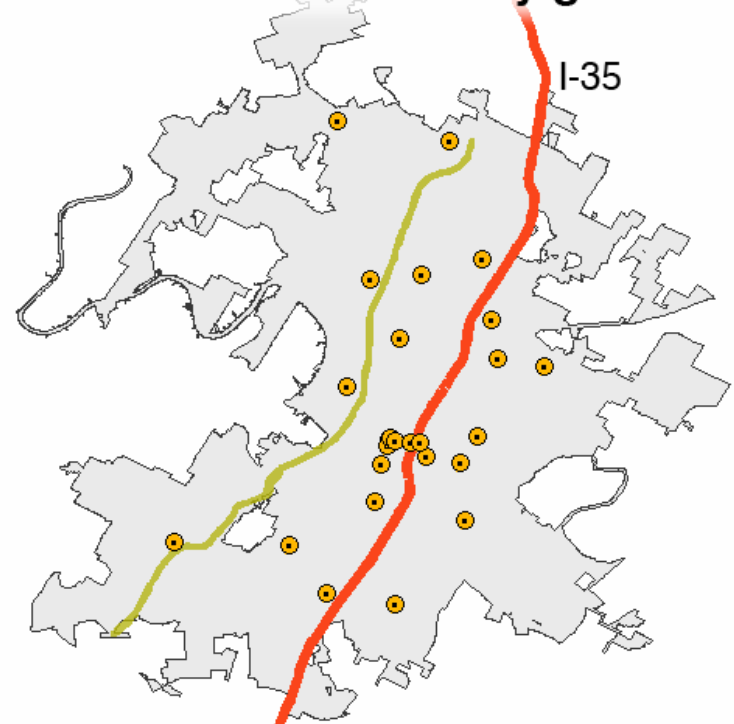
# City's Role in Narrowing Digital Divide: Public-Private Hotzones in Austin, Texas

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Public Wi-Fi venues - AWCP only



Public Wi-Fi venues - City gov't



AWCP=Austin Wireless City Project

Source: Martha Fuentes-Bautista and Nobuya Inagaki, "Wi-Fi's Promise and Broadband Divides: Reconfiguring Public Internet Access in Austin, Texas," Telecommunications Policy Research Conference, September 2005, [www.tprc.org](http://www.tprc.org)

# Leveraging City Resources

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- **Infrastructure-based resources**
  - Traffic and street light poles
  - Underground conduits
  - Rooftops of municipal buildings (antenna placement / real-estate model)
  - Towers (water, fire, etc.)
  - Fiber rings/backhaul connections
  - Essentially, any right-of-way or city property that facilitates wireless networking
- **City's buying power is also an important resource**
  - Demand aggregation / anchor tenant strategies
- ***Inventory* of these resources is a critical first step**
- **Can Boston non-profit institutions be leveraged in analogous ways?**
  - Health, education, arts, housing, historical, community, etc.
  - Existing wireless networks (Boston Foundation report)
  - May be especially relevant to digital divide issues (San Francisco model)

# Best Practice Partnerships Avoid Exclusivity

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- **In the process of facilitating the first wireless entrant, don't accidentally hinder the next one**
  - There can and will be many wireless networks, services, business models, etc.
  - Not all will look like traditional service providers (e.g. organic mesh networks)
- **How to manage multi-party access to city facilities?**
  - Consider treating like rights-of-way
- **“Open Access” Model Proving Popular**
  - Generally, means multiple competitors use a common shared network infrastructure, and customers can elect services from alternative suppliers
  - But requires clarification along many dimensions



# Open Access Decision Points (1)

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- **To which services?**
  - Voice telephony
  - Data (ISP): Internet access
  - Data (transport): broadband “circuits”
  - Video: broadcast TV, VoD
- **At what (technical) layer?**
  - Physical
  - Data link
  - Network/IP

Based on Marvin Sirbu, William Lehr, and Sharon E. Gillett. [“Broadband Open Access: Lessons from Municipal Network Case Studies.”](#) 32nd Annual Telecommunications Policy Research Conference, October 1-3, 2004, Arlington, VA. Also see [Case Study Appendix](#).

# Open Access Decision Points (2)

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- **With what partnership model?**
  - Legal structure of network operator, partnership?
  - Network operator also competes at retail?
  - What control over identity and number of service providers?
  - Who bills customer? Who pays whom on what basis?
  - Wholesale prices negotiated or regulated?
- **What shared facilities beyond “last-mile” distribution?**
  - Shared middle-mile backhaul to tier 1 ISPs
  - Shared ISP peering point (NAP or IXP)
  - Shared telephony gateway
  - Shared video head end

# Amsterdam, Netherlands

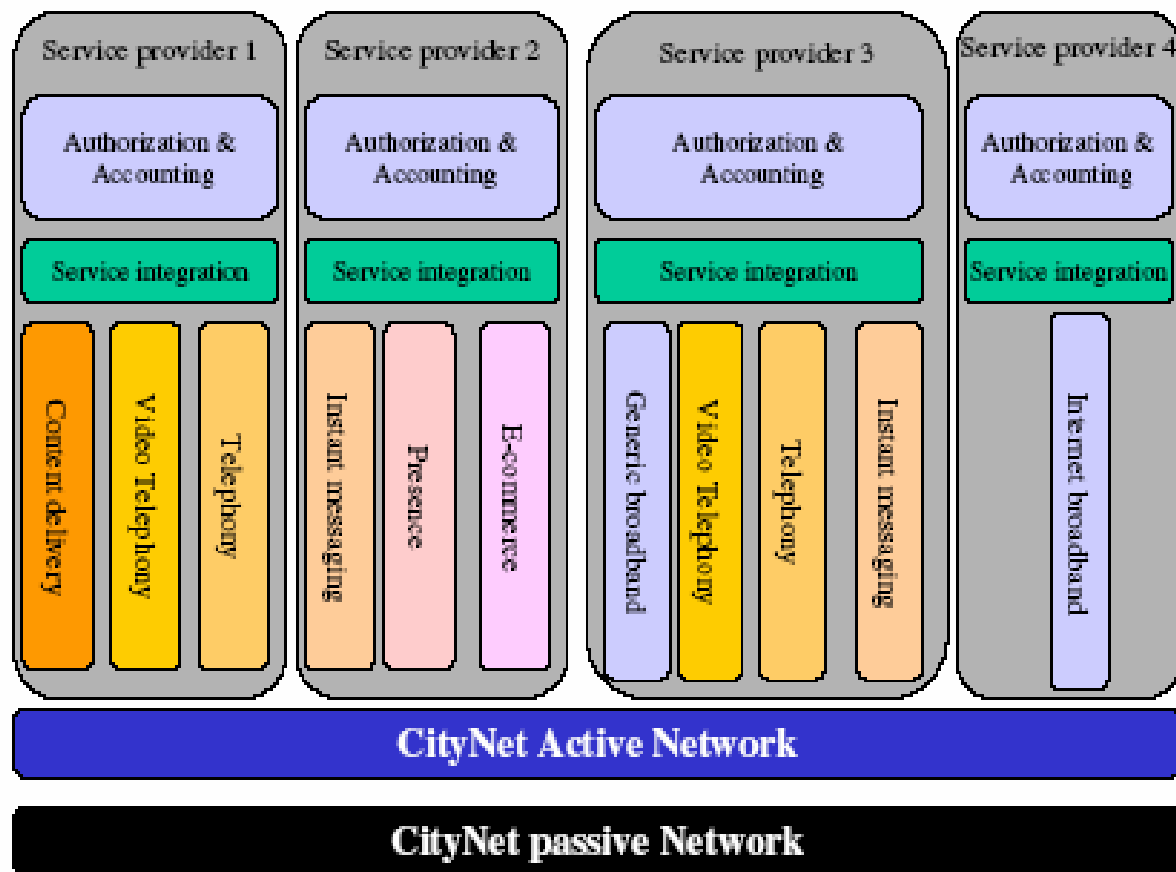


Figure 1. Multiple Service Providers on one network

Source: <http://www.citynet.nl/upload/Wholesale-bandwidth-Amsterdam-Citynet.pdf>

# Publications on Municipal Broadband: MIT Communications Futures Program

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William H. Lehr, Marvin A. Sirbu, and Sharon E. Gillett, "[Wireless is Changing the Policy Calculus for Municipal Broadband](#)" Government Information Quarterly, forthcoming.

Marvin A. Sirbu, William H. Lehr, and Sharon E. Gillett, "[Evolving Wireless Access Technologies for Municipal Broadband](#)" Government Information Quarterly, forthcoming.

Sharon E. Gillett, William H. Lehr, and Carlos Osorio, "[Municipal Electric Utilities' Role in Telecommunications Services](#)," Telecommunications Policy, forthcoming.

Sharon E. Gillett, William H. Lehr & Carlos A. Osorio. "[Municipal Trends](#)," Broadband Properties Magazine, September 2004. Excerpted from "[The Municipal Role in U.S. FTTH Market Growth](#)," FTTH Council's 3rd Annual FTTH Conference & Expo, October 3-6, 2004, Orlando, FL.

Marvin Sirbu, William Lehr, and Sharon E. Gillett. "[Broadband Open Access: Lessons from Municipal Network Case Studies](#)," 32nd Annual Telecommunications Policy Research Conference, October 1-3, 2004, Arlington, VA. Also see [Case Study Appendix](#).

Sharon E. Gillett, William H. Lehr, and Carlos Osorio, "[Local Government Broadband Initiatives](#)," Telecommunications Policy 28, August/September 2004, pp. 537-558.

Carlos A. Osorio, "[Bits of Power: The Involvement of Municipal Electric Utilities in Broadband Services](#)," MIT MS Thesis, June 2004.

## **Additional Information**

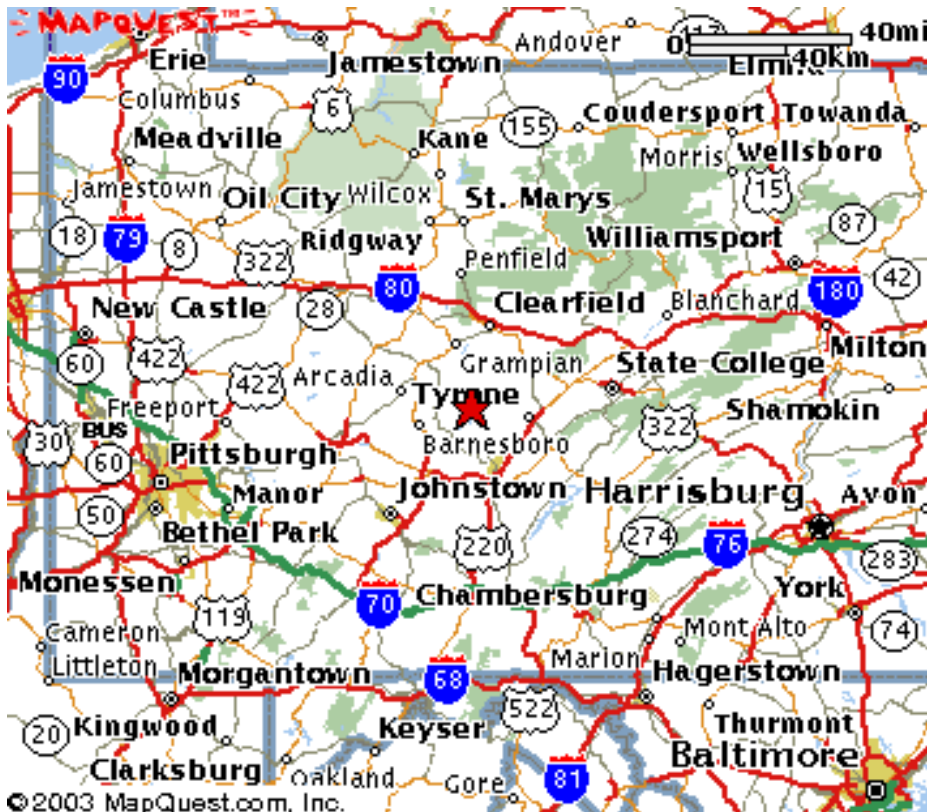
# Public Policy and Municipal Broadband

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- **State restrictions on municipal broadband upheld by Supreme Court**
  - 13 states had enacted limits on municipal communications
    - Varying restrictions on services, business model, approval process, imputed costs, cross-subsidy etc.
  - *Nixon vs. Missouri Municipal League*, March 2004
    - Telecom Act of 1996 does not pre-empt state restrictions on municipal entry, despite “any entity” language of section 253(a)
  - 5 new additions since: Pennsylvania, Colorado, Florida, Louisiana, Tennessee
- **Federal proposals: Congressional ping-pong, 2005**
  - May, H.R. 2726 (Sessions): ban municipal communications if private offers in same area
  - June, S. 1294 (Lautenberg-McCain): ban state bans; anti-discrimination clause
  - July, S. 1504 (Ensign): broadly deregulatory (Titles I, II, VI); munis defer to private
  - Sept/Nov, H.R. xxxx (Barton-Dingell): network neutrality (sort of); ban state and federal bans on public BITS, VoIP, video (sec. 409)

Sources: American Public Power Association ([www.appanet.org](http://www.appanet.org));  
Baller Herbst Law Group ([www.baller.com](http://www.baller.com))

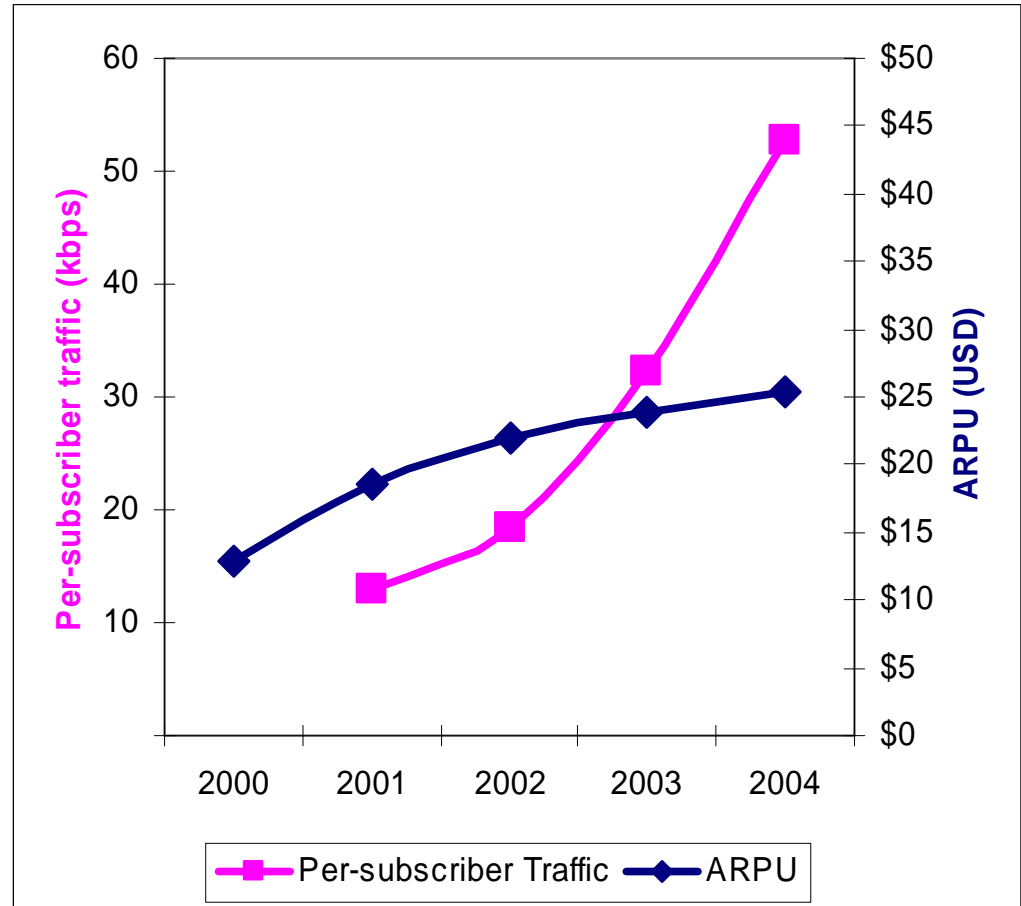
# Glendale School District, Flinton, Pennsylvania



- **\$457,000 “digital divide” grant - GAIN**
- **Extend wireless bb Internet access from school to nearby communities, schools**
- **Mobilize community support for “100 laptops” – tech and job skills training**

# Will Broadband be “Free”? (TANSTAAFL)

- **Normative: *Should* be free, as a matter of equity**
  - Externality benefit from those who wouldn't otherwise be on net
  - Analogous to public libraries
    - Info access key to democracy
    - Compete with bookstores, but limited
  - Expect some users will pay for more: support, bandwidth, etc.
- **Positive: Cost structure makes “free” more efficient**
  - Low capital costs of wireless
  - Effectiveness of targeted (Google) ads as revenue source
  - But: Operational costs?
    - Billing (no)
    - Support
    - Bandwidth (middle-mile)

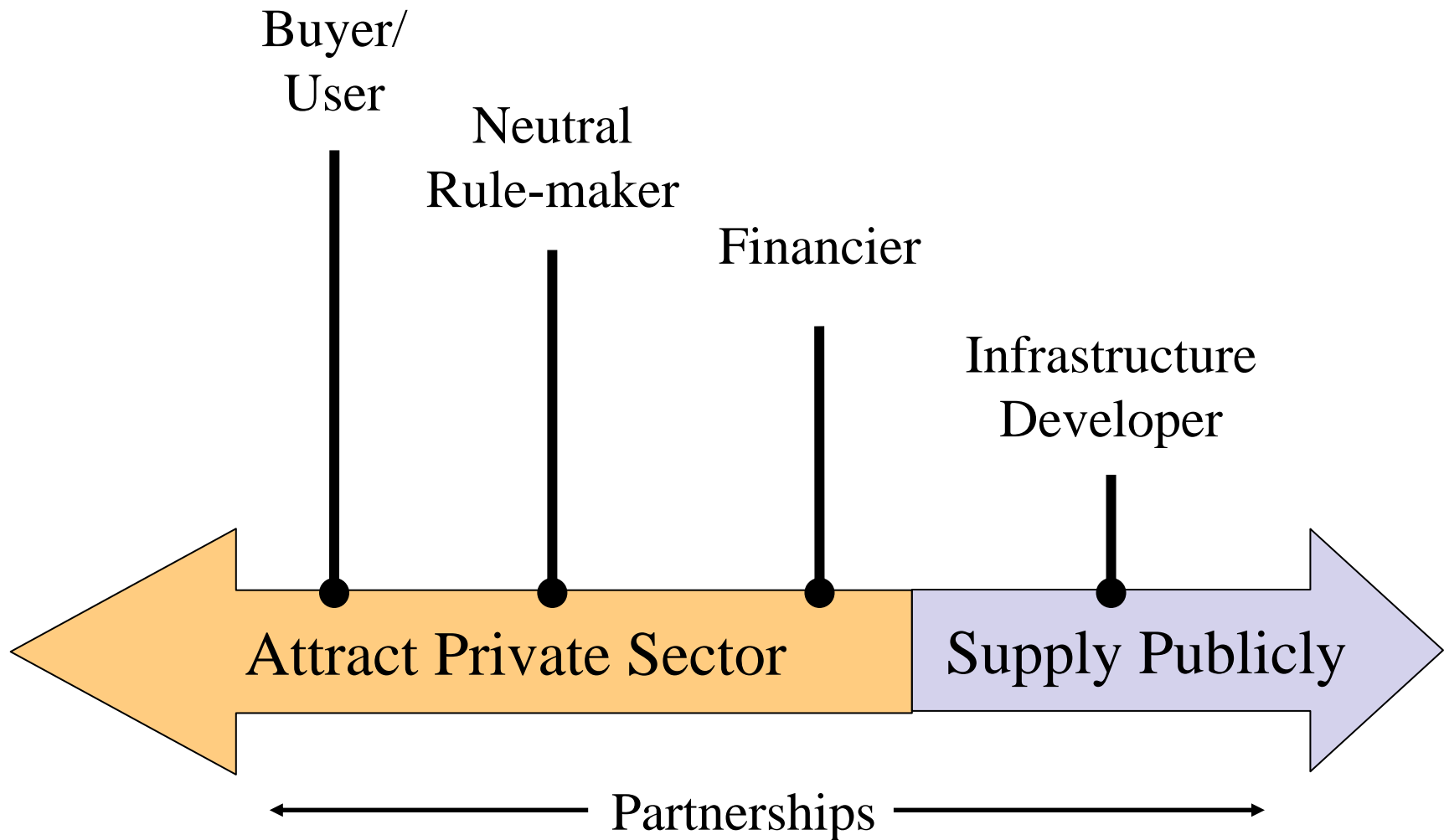


## Korea Telecom Traffic vs. Revenue Growth

Sources: Korean Times, [KT Seeks Usage-Based Internet Pricing](#), 3/29/05;  
KT Corporation 2004 Annual Report.



# Taxonomy: Role of Gov't *vis a vis* Broadband



# Government as Buyer/User

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Type of Government Intervention	Examples
Measure Demand	<ul style="list-style-type: none"><li>• Demand Assessment (Surveys or online registration)</li></ul>
Stimulate Demand	<ul style="list-style-type: none"><li>• “Extension” programs (Training businesses in effective ICT use)</li><li>• Community technology centers (Training citizens, primarily disadvantaged, in ICT use, e.g. Atlanta);</li><li>• Sectoral pilots (E-government, distance education, telemedicine etc.)</li><li>• Community information services (Web pages for local businesses and community groups, e.g. Blacksburg [Virginia] Electronic Village)</li></ul>
Aggregate Demand	<ul style="list-style-type: none"><li>• Buying Cooperative (Group pricing)</li><li>• Anchor Tenant (Government’s telecom contract in exchange for broader infrastructure availability, e.g. Chicago CivicNet)</li></ul>

**Aggregation usually requires a regional approach**

# Government as Rule-Maker

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Type of Policy	Examples
Access to Local Facilities	<ul style="list-style-type: none"><li>• Franchising/Licensing and Rights of Way (Use of streets and other public property)</li><li>• Utility pole attachment (Rules for adding wires and equipment)</li><li>• Zoning (Rules for facilities placement, esp. wireless antennas)</li></ul>
Coordinated Planning	<ul style="list-style-type: none"><li>• Conduit installation during road construction (e.g. Chicago CivicNet)</li><li>• Antenna siting (e.g. Dubuque, IA)</li></ul>
Industry-specific Regulation	<ul style="list-style-type: none"><li>• Negotiation of cable franchise agreement (Cable system upgrades, deployment of networks for municipal use, schools and libraries, etc.)</li></ul>

**More classic “policy” - at the local level**

# Government as Financier

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Target of Subsidy	Examples
Providers	<ul style="list-style-type: none"><li>• Grants</li><li>• Loans (typically at lower-than-market interest rates)</li><li>• Tax Incentives</li></ul>
Users	<ul style="list-style-type: none"><li>• Equipment</li><li>• Service (typically for a limited time)</li></ul>
Community Groups	<ul style="list-style-type: none"><li>• Planning Grants</li><li>• Training</li><li>• Non-profit deployments</li></ul>

**Bigger pots at higher layers of government**

# Gov't as Infrastructure Developer

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Decision Factor	Options
Targeted Users	<ul style="list-style-type: none"><li>• <b>Government</b> (including schools, municipal facilities)</li><li>• <b>Businesses</b></li><li>• <b>Residents</b></li></ul>
Type of Infrastructure	<ul style="list-style-type: none"><li>• <b>Ducts or conduit</b> (possibly with dark fiber)</li><li>• <b>“First mile” network</b> (connections to customer premises)</li><li>• <b>Interconnection point(s)</b> (e.g. neutrally administered “carrier hotel”)</li><li>• <b>“Middle mile” connection</b> (backhaul links to other locations)</li></ul>
Technology (when applicable)	<ul style="list-style-type: none"><li>• <b>Wireless</b> (unlicensed or licensed)</li><li>• <b>Wired</b> (copper, hybrid fiber-coax, fiber)</li></ul>
Services	<ul style="list-style-type: none"><li>• <b>Broadband</b> (Internet access, other data communications)</li><li>• <b>Video</b> (cable TV)</li><li>• <b>Voice</b> (telephony)</li></ul>
Government Responsibility	<ul style="list-style-type: none"><li>• <b>Finance</b> (bonds: special issue or general obligation)</li><li>• <b>Build</b> (may contract to private sector)</li><li>• <b>Operate</b> (may contract to private sector)</li></ul>
Business Model	<ul style="list-style-type: none"><li>• <b>Wholesale</b> (local government sells capacity to carriers, or leases dark fiber to anyone but with no associated service, or provides “open access” platform to multiple ISPs)</li><li>• <b>Retail</b> (local government sells higher-level services to end users)</li></ul>

**Almost entirely local**